Light Absorption by Soot

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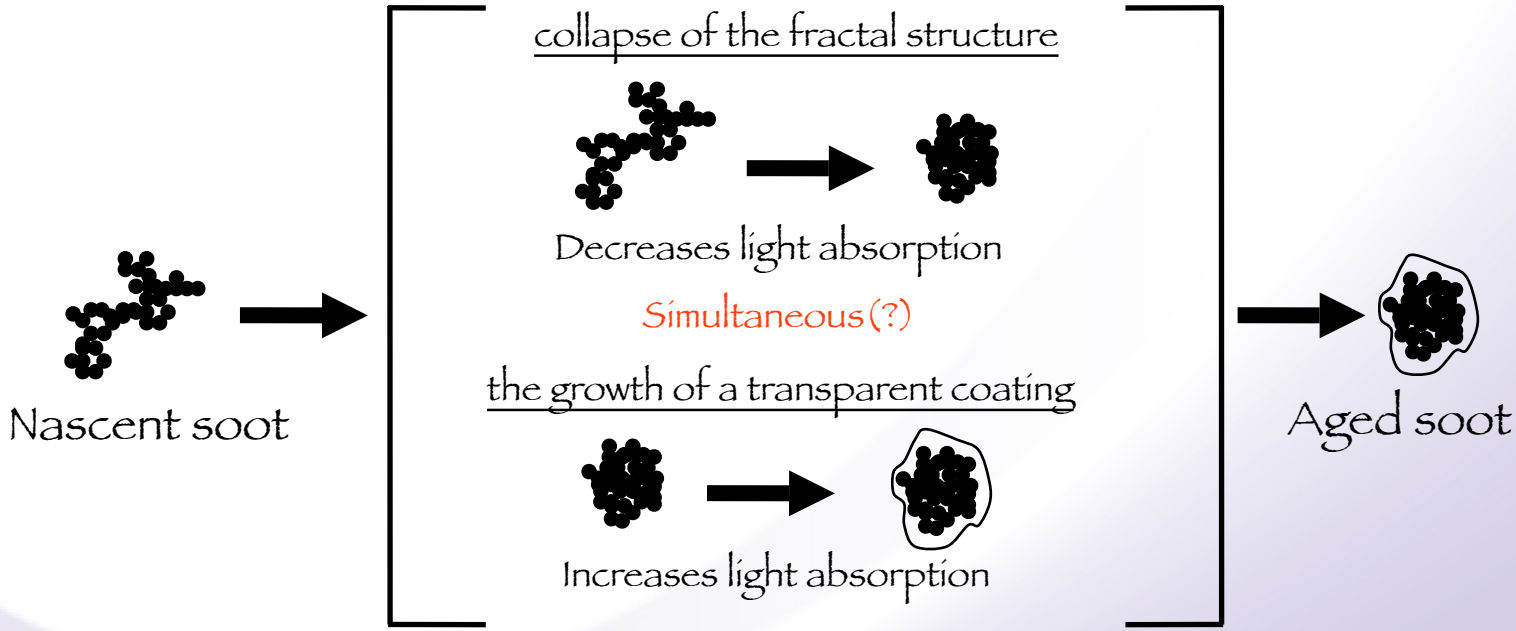
Steve's voice resonating in the halls of BNL on how to prepare for an ASP highlight:

"Whatcha did,
why ya did it,
how ya do it,
whatcha found.....in 6 minutes"

What I'm doing & why...

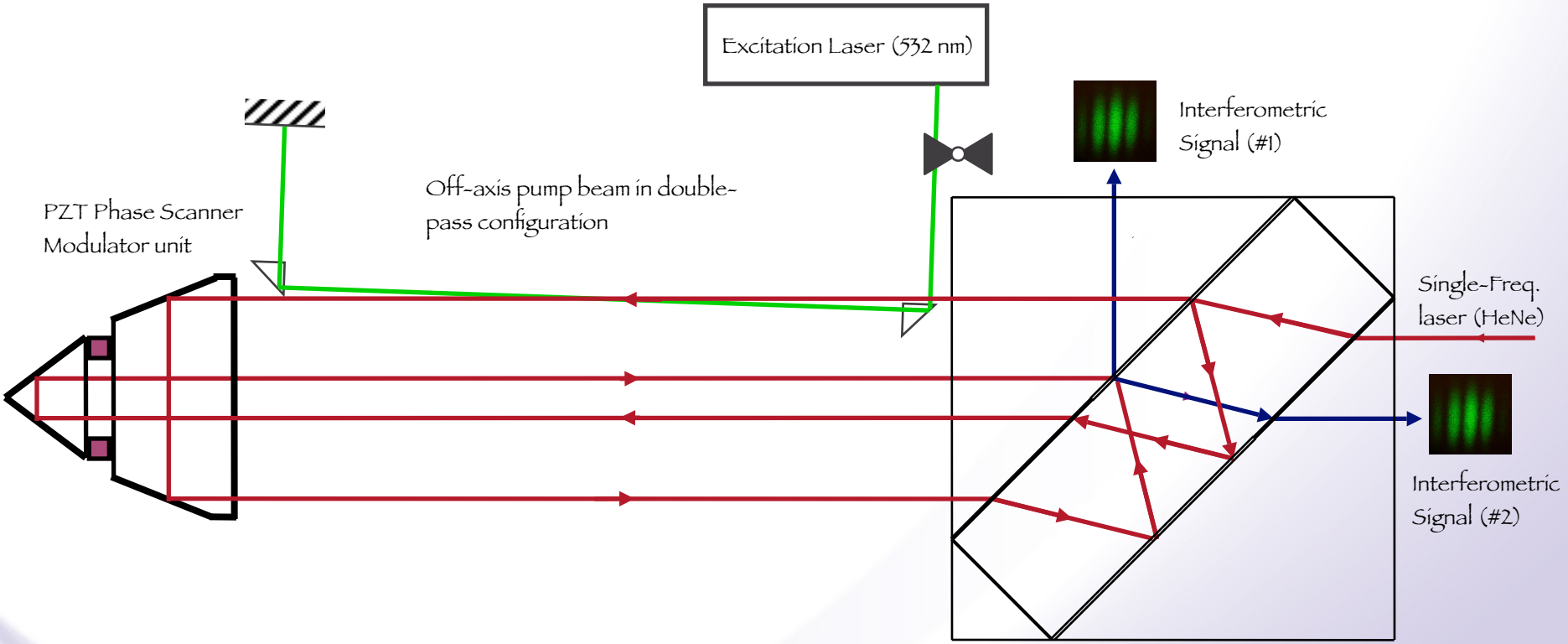
To better quantify the contribution of light absorption to aerosol radiative forcing.

Issue: role of coating (aging) on soot light absorption



How I'm doing it...

Utilized photothermal interferometric technique

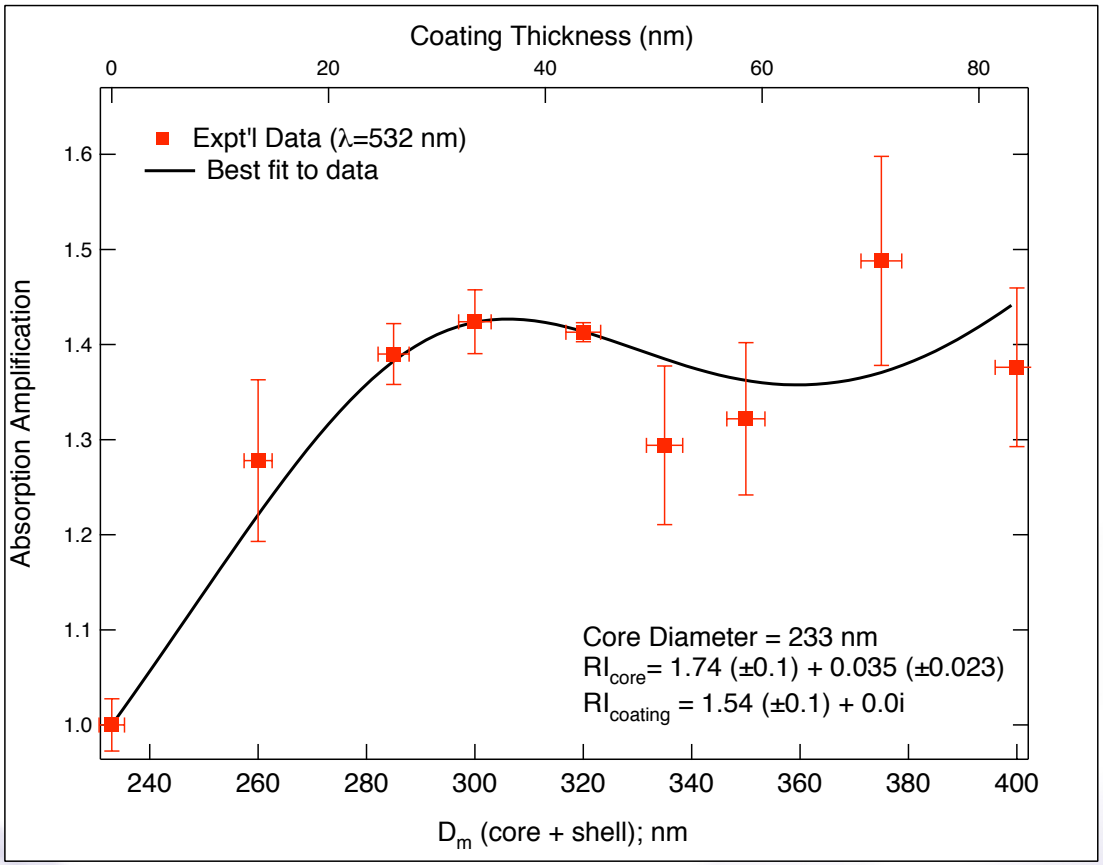


Sedlacek, RSI (2006)

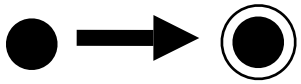
Shift in interference pattern ∝ aerosol light absorption

Black-dye PSL Spheres: model system

Study coating induced lensing effect on light absorption without fractal collapse.



Model System



Coating material:
Dibutyl phthalate

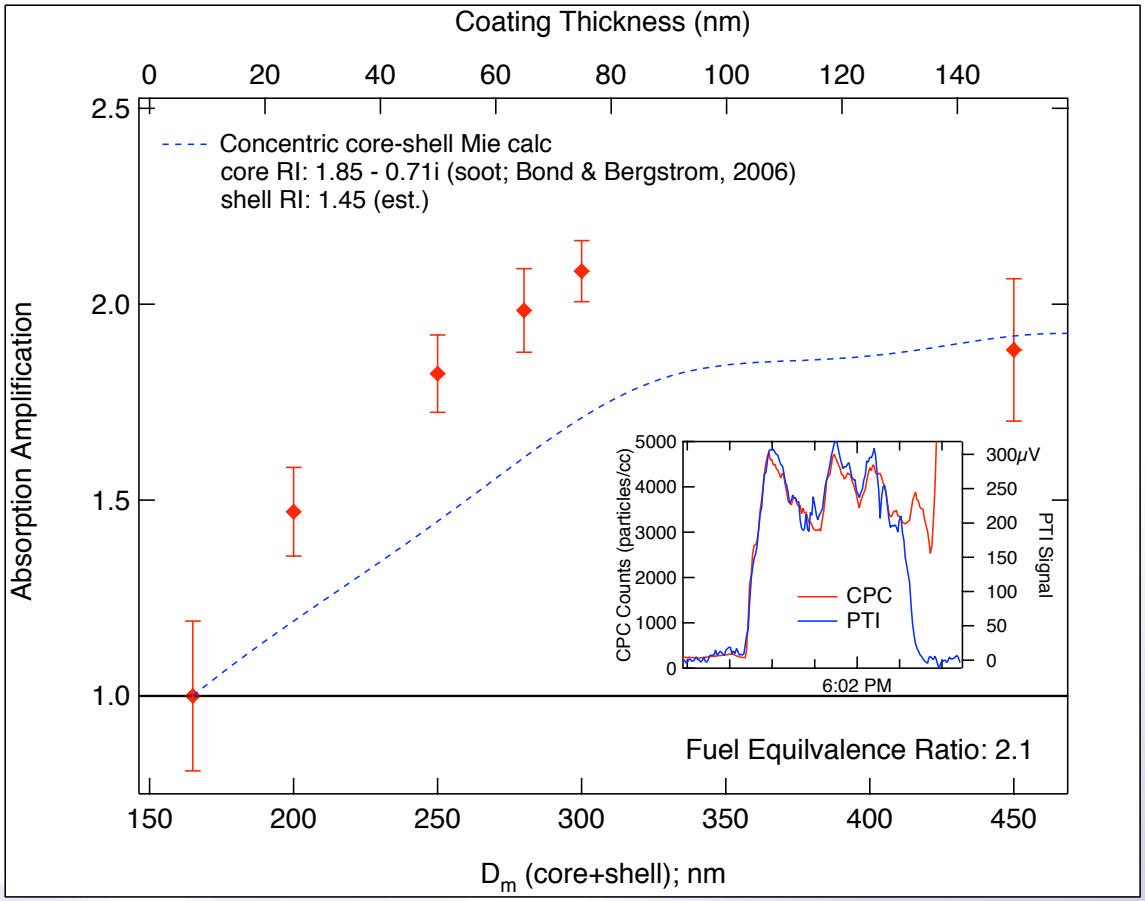
Core:
BPSL (Duke Scientific)

Concentric core-shell code:
Mätzler (2002)

Bond & Bergstrom (2006): "Coatings always increase absorption, never decrease it"

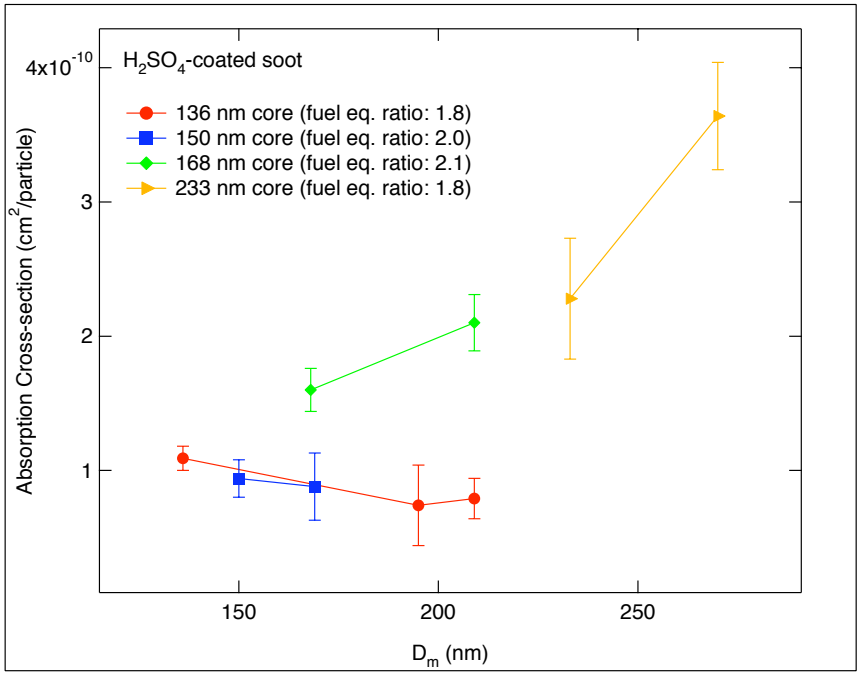
Coating Flame-generated Soot: DOS

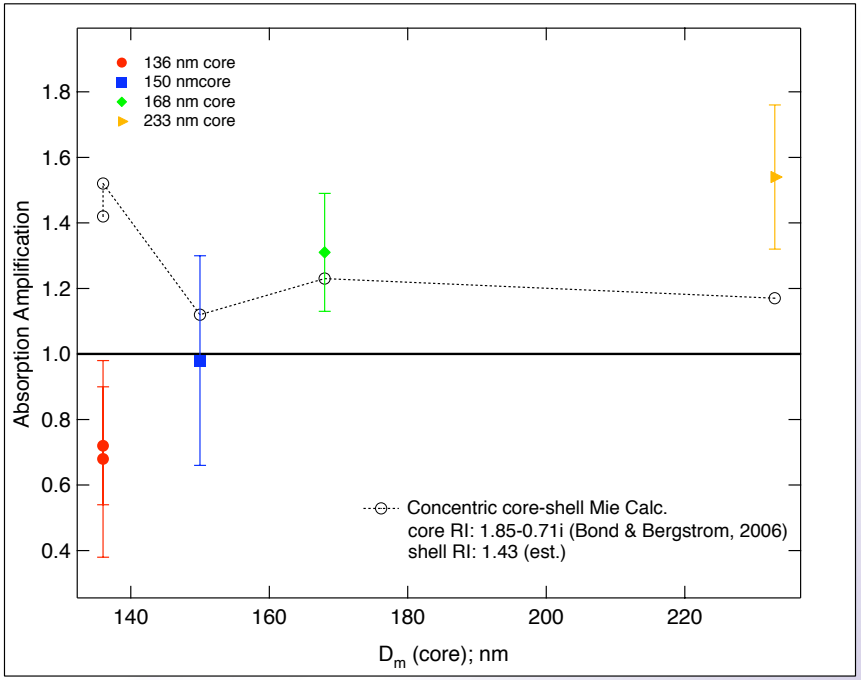
Light absorption enhancement observed for dioctyl sebacate (DOS) encapsulated soot. The blue line is a concentric core-shell model Mie calculation for a DOS coated, 165 nm diameter soot particle.



Coating Flame-generated Soot: H_2SO_4

Complex light absorption enhancement behavior observed for sulfuric acid coated soot.



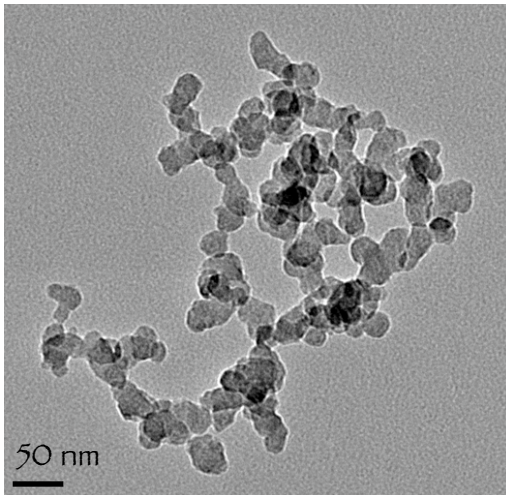


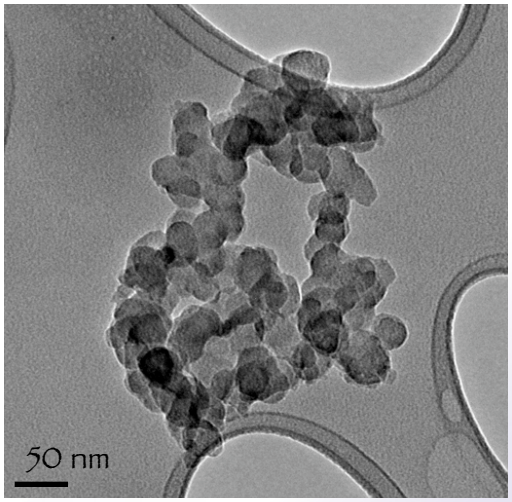
Smaller cores show little to no light absorption enhancement while larger cores exhibit AA similar to that observed with DOS-coat soot and the DBP-coated BPSL model system.

Coating Flat Flame-generated Soot: H_2SO_4

Potential explanation ~

Morphology: Steric resistance present in the larger fractal aggregates prevent facile collapse because more movement, in the right order, is needed for substantial morphological change to be realized.





TEM images: BNL Center for Functional Nanomaterials, Lihua Zhang

Conclusions/thoughts

- Coating 'almost' always results in light absorption amplification

  Experimentally observed AA with DOS-encapsulated soot.

  Preliminary findings with H_2SO_4-coated soot shows more complex behavior: Smaller aggregates show no AA while larger aggregates exhibit measurable enhancement.

- Follow on to 2008 Boston College-Aerodyne Soot project is highly desirable. In addition to further probing into morphological influences on light absorption, initiate examination of semi-absorbing coatings on soot light absorption.